Using Cox Regression in studying the factors that affect small and medium Enterprises and their impact on the Saudi Arabian Economy

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Abstract:
Backed by the Saudi Vision 2030, The Kingdom of Saudi Arabia (KSA) has paid a special attention to the sector of Small & Medium Enterprises (SMEs), in view of the economic and social importance of SMEs, the role they play in the overall development process in general and economic development in particular. This researcher paper aims to deciding the most important factors affecting the development and success of SMEs. This objective is achieved by conducting a statistical analysis using the Cox regression model to analyze the data through using Statistical package for social sciences (SPSS). The sample of the study consists of 1292 enterprises from different regions of the Kingdom of Saudi Arabia. The study found several variables that have a significant effect are the age, educational level, time available, reason for the establishing project: independence at work, academic specialization, diversity of income sources, and others not mentioned such as love of trade or professional activity, type of enterprise location (Privet/Rented), number of employees, obstacles of starting the enterprise: difficulties marketing, current problems of the enterprise: difficulty to have a place for expansion, rising wages, government services fees, administrative difficulties, competition with the local and foreign goods, government entities that deal with it: Bank, and Ministry of Labor and Social Development, difficulties of borrowing, feasibility study, and marketing mechanisms.
Key Word: *Small and Medium Enterprises; Development; Economy; Cox Regression.*

Date of Submission: 10-02-2020   Date of Acceptance: 25-02-2020

I. Introduction

Backed by the Saudi Vision 2030, The Kingdom of Saudi Arabia (KSA) has paid a special attention to the sector of Small & Medium Enterprises (SMEs). One of the most important objectives of Saudi Vision 2030 is to increase employment rates by enabling job creation through the increase of SMEs contribution to the economy. KSA aspires to raise the contribution of SMEs in KSA GDP from 20% to 35%. Consequently, it has become necessary to evaluate the current situation of SMEs, strive to increase the effectiveness of these enterprises and overcome all the difficulties and obstacles they face with a view to enhancing the role they play in the process of economic development, as these enterprises may face some difficulties and obstacles during practical course.[1]

SMEs are among the most important drives of economic growth in developed countries in general and developing countries in particular and the mainstay of the economy. The importance of enhancing the SMEs sector appears in pushing the process of economic and social development and activating the role they play in addressing certain main problems facing different economies because they are considered an appropriate and effective mechanism to implement self-employment, combat unemployment, increase exports, open new markets, diversify sources of income and expand the productive sector. SMEs also create an avenue for developing managerial, technical, production and marketing skills.[2,3]

In view of the economic and social importance of SMEs, the role they play in the overall development process in general and economic development in particular, and the many advantages that they enjoy, such as their large absorptive capacity for labor and the small size of investment in them, SMEs presence alongside large enterprises has become a must. Additionally, SMEs open up a great sphere for individual initiatives and self-employment, which reduce the pressure on the government sector in providing job opportunities. Therefore, the prevailing idea of the concept of employment among young people that work means a job in the government or private sector has to be changed. This concept has become no longer logical as the public and private sectors cannot provide future jobs for all job seekers.[4]

There are basic elements that must be available in order for SMEs to continue to play their required and effective role. As we know, the individual desire of young men and women to work on freelance basis will not

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continue without social motivation, legal protection, financial guarantee, and government support. This will not lead to achieving positive results and hence efforts have to be integrated so that long-term success could be achieved.[5,6]

In this paper, we will study the current situation of SMEs in Saudi Arabia by studying and analyzing the factors that affect their continuation and stability. It also aims to examine the problems and obstacles that these enterprises can face and to provide some mechanisms and procedures to solve these problems or limit them according to the Saudi Vision in 2030.

To achieve this objective, the Cox Regression Model will be applied. The Cox Regression Model is one of the methods that is used in survival analysis which considers time the key factor in the analysis. This method is used to examine the relationship between the time before the occurrence of the event (the time when enterprises start until a specific time point may be the beginning of their work or development and their transition to a more advanced stage) which is called survival time with several independent variables, regardless of being quantitative, descriptive or a combination of both. The dependent variable consists of two parts: a descriptive binary value variable and a time variable that precedes the event.[7,8]

In this study, the factors that affect the development of the SMEs will be determined by using the Cox Regression Model and Suggest some solutions and procedures to development the SMEs through the results of the study.

II. Material And Methods

In this section, the concept of the Cox Regression Model and its application will be illustrated using SPSS, an application to the data of Saudi Small & Medium Enterprises (SMEs). The required data is taken from a questionnaire, the data included 1292 Saudi SMEs from different regions of the Kingdom of Saudi Arabia the period from February 2019 to January 2020 and 55 variables.

Evaluate the suitability of the model by two methods:
1- Measure the effect of each variable individually.
2- Measure the effect of all variables together.

Factors that affect the development of the SMEs will be determined by using the Cox Regression Model will be done in two stages:
1-The stage of development of the Enterprise from the micro to the small.
2- The stage of development of the Enterprise from small to medium.

In this paper, the steps are explained in addition to their applications to the data of the study using the statistical program Statistical Package for Social Sciences SPSS which is one of the most popular applications.

2.1The stage of development of the Enterprise from the micro to the small:

2.1.1 Measure the effect of each variable individually:
The Chi-Square test was used to examine if there is a relationship between the independent variable and the dependent variable by testing the following hypothesis:[9]
H_0: There is no relationship between the independent variable and the dependent variable.
H_1: There is relationship between the independent variable and the dependent variable.

Table (1): Chi-Square test.

Independent variables	Chi-Square	Df	Sig
Gender	805.412	1	.000
Age	314.097	4	.000
Marital status	2459.373	3	.000
Educational level	1428.630	6	.000
Number of Family Members	422.747	2	.000
Time available	114.453	3	.000
Reason for the establishing project: Genetics	829.225	1	.000
Reason for the establishing project: Academic specialization	666.747	1	.000
Reason for the establishing project: Independence at work	6.853	1	.009
Reason for the establishing project: Diversity of income sources	215.961	1	.000
Reason for the establishing project: Others not mentioned (love of trade or professional activity, etc.)	595.044	1	.000
Practicing the Industry and having the management and supervision	601.839	2	.000
Duration of enterprise preparation	343.550	3	.000
Enterprise Region	587.142	4	.000

Type of enterprises activity	1225.867	4	.000
Considering the needs of the region	583.490	1	.000
Legal form of the enterprise	1472.758	2	.000
life of the enterprise	443.083	3	.000
Type of enterprise location (Privet/Rented)	1523.333	1	.000
Number of employees	201.607	2	.000
Obstacles of starting the enterprise: Lack of funding	88.368	1	.000
Obstacles of starting the enterprise: Lack of employment	3.186	1	.074
Obstacles of starting the enterprise: The complexity of regulations	75.455	1	.000
Obstacles of starting the enterprise: un availability of a place	399.632	1	.000
Obstacles of starting the enterprise: Lack of administrative experience	263.819	1	.000
Obstacles of starting the enterprise: Difficulties marketing	73.402	1	.000
Obstacles of starting the enterprise: Absence of direction and guidance	19.912	1	.000
Obstacles of starting the enterprise: Other than the above	1086.428	1	.000
Current problems of the enterprise: Difficulty in continuity of finance	24.977	1	.000
Current problems of the enterprise: Difficulty to have a place for expansion	299.756	1	.000
Current problems of the enterprise: Rising wages	64.513	1	.000
Current problems of the enterprise: Government services fees	331.455	1	.000
Current problems of the enterprise: Administrative difficulties	329.292	1	.000
Current problems of the enterprise: Competition with the local and foreign goods	127.788	1	.000
Current problems of the enterprise: Other than the above	1051.416	1	.000
Sources of funding the enterprise	1139.265	4	.000
Difficulties of borrowing	374.805	4	.000
Government entities that deal with it: chamber of Commerce	505.784	1	.000
Government entities that deal with it: Banks	28.673	1	.000
Government entities that deal with it: Human Resources Development Fund	337.986	1	.000
Government entities that deal with it: Ministry of Labor and Social Development	200.510	1	.000
Government entities that deal with it: Ministry of Commerce and Investment	203.894	1	.000
Government entities that deal with it: Industrial Development Fund	569.207	1	.000
Government entities that deal with it: Other than the above	344.581	1	.000
Difficulties with the official authorities	775.457	1	.000
Updating laws	805.412	1	.000
Receiving training programs and courses	329.292	1	.000
Feasibility study	1176.117	3	.000
Business Incubators and Accelerators	3002.340	3	.000
Marketing mechanisms	734.159	4	.000
The role of small enterprises: creating jobs	532.899	1	.000
The role of small enterprises: limiting import	1.023	1	.312
The Role of Small Enterprises: Competition	23.802	1	.000
The role of small enterprises: varying the sources of income	254.244	1	.000
The role of small enterprises: Training local workers to do different skills	3.186	1	.074

Table(1) shows the results of this test which indicate that there are 52 variables each of them has a significant relationship with the development of the enterprise.

2.1.2 Measure the effect of all variables together:
We will use the Cox Regression Model to testing the following hypothesis:
H_0: There is no effect of independent variables on the dependent variable.
H_1: There is effect of independent variables on the dependent variable.
The relationship between the Hazard Rate and a set of independent variables can be described by the Cox regression model, which was proposed by Cox in 1972. Since T is a random variable connected, the basic formula of the model is as follows:[10]

$$h(t|x_i) = h_0(t)e^{\sum_{i=1}^{n} x_i \beta_i}$$

whereas :

$h(T/x_i)$ The conditional hazard function of the event occurring at time T for units that has independent variables x_i .

$h_0(t)$ The baseline hazard rate when all independent variables are zero, and this limit describes the risk change with time.

t Is the elapsed time.

$\beta_1, \beta_2, ..., \beta_n$ Are regression coefficients that are estimated.

$x_1, x_2, ..., x_n$ Explanatory variables.

$e^{\sum_{i=1}^{n} x_i \beta_i}$ Is the relative hazard that does not depend on time, the effect of the explanatory variables does not change to change **t**, where it describes the change of hazard with the change of values of independent variables,

Table (2): Tests of Model Coefficients (Cox Regression).

Chi-Square	Df	Sig
344.716	51	.000

As it is shown in the table (2) that the statistical model that is reconciled is statistically significant. Therefore, this shows that the variables in the model have a statistically significant impact and contribution.

Table (3): Variables in the Equation (Cox regression).

	β	SE	Wald	df	Sig	Exp(β)
Age	-.149	.067	5.055	1	.025	.861
Educational level	.172	.078	4.815	1	.028	1.187
Reason for the establishing project: Independence at work	.829	.149	30.806	1	.000	2.290
Reason for the establishing project: Diversity of income sources	.350	.153	5.222	1	.022	1.419
Reason for the establishing project: Others not mentioned (love of trade or professional activity)	.346	.170	4.138	1	.042	1.414
Type of enterprise location (Privet/Rented)	.373	.186	4.015	1	.045	1.452
Number of employees	.515	.113	20.756	1	.000	1.6724
Obstacles of starting the enterprise: Difficulties marketing	-.350	.125	7.849	1	.005	1.420
Current problems of the enterprise: Government services fees	-.582	.156	13.874	1	.000	.559
Current problems of the enterprise: Competition with the local and foreign goods	-.333	.119	7.830	1	.005	1.395
Difficulties of borrowing	-.408	.071	33.277	1	.000	.665
Feasibility study	.242	.107	5.143	1	.023	1.273
Marketing mechanisms	.199	.062	10.160	1	.001	1.220

From the table (3) can be seen the independent variables that have an impact on the development and success of the enterprise. They: age, educational level, reason for the establishing project: Independence at work,reason for the establishing project: diversity of income sources, reason for the establishing project: Others not mentioned (love of trade or professional activity),type of enterprise location (Privet/Rented), number of employees, obstacles of starting the enterprise: difficulties marketing, current problems of the enterprise: government services fees, current problems of the enterprise: competition with the local and foreign goods,difficulties of borrowing, feasibility study, and marketing mechanisms.

Exp (β) values indicate that as the entrepreneurs age increases, the chance of development and success of the enterprises decreases. Also, the higher the educational level of the enterprise owner, the greater the opportunity for development and success. The chances of development and success of the enterprises increase due to certain factors varying of income sources, independence at work and other reasons such as love of trade or professional activity are one of the reasons for the establishing of the project, as well as increasing the number of employees. The chances of development and success of the enterprise decreases, if problems of the enterprise increase. These problems include: difficulties marketing, government services fees or competition with the local and foreign goods. Likewise, borrowing difficulties lead to reducing the opportunity for enterprise development and success. These difficulties are due to weak guarantees, complicated procedures, and high interest rates. Also, doing a feasibility study for the enterprises and interest in marketing mechanisms increases the opportunity for development and success.

From the above, the Cox Regression Model can be formulated as follows:

$$\operatorname{Log} h(t) = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13}$$

$$\operatorname{Log} h(t) = -0.149 x_1 + 0.172 x_2 + 0.829 x_3 + 0.350 x_4 + 0.346 x_5 + 0.373 x_6 + 0.515 x_7 - 0.350 x_8 - 0.582 x_9 - 0.333 x_{10} - .408 x_{11} + .242 x_{12} + .199 x_{13}$$

whereas:

x_1 : Age.

x_2 : Educational level.

x_3 :Reason for the establishing project: Independence at work.

x_4 : Reason for the establishing project: Diversity of income sources.

x_5 : Reason for the establishing project: Other than the above.

x_6 :Type of enterprise location (Privet/Rented).

x_7 : Number of employees.

x_8 : Obstacles of starting the enterprise: Difficulties marketing.

x_9 : Current problems of the enterprise: Government services fees.

x_{10} :Current problems of the enterprise: Competition with the local and foreign goods.

x_{11} :Difficulties of borrowing.

x_{12} :Feasibility study.

x_{13} :Marketing mechanisms.

2.2The stage of development of the Enterprise from small to medium:

2.2.1 Measure the effect of each variable individually:

The Chi-Square test was used to examine if there is a relationship between the independent variable and the dependent variable by testing the following hypothesis:

H_0: There is no relationship between the independent variable and the dependent variable.

H_1: There is relationship between the independent variable and the dependent variable.

Table (4): Chi-Square test.

Independent variables	Chi-Square	Df	Sig
Gender	487.648	1	.000
Age	354.165	4	.000
Marital status	1050.429	2	.000
Educational level	373.048	3	.000
Number of Family Members	429.769	2	.000
Time available	219.509	3	.000
Reason for the establishing project: Genetics	335.502	1	.000
Reason for the establishing project: Academic specialization	278.571	1	.000
Reason for the establishing project: Independence at work	90.264	1	.000
Reason for the establishing project: Diversity of income sources	107.260	1	.000
Reason for the establishing project: Others not mentioned (love of trade or professional activity, etc.)	64.733	1	.000
Practicing the Industry and having the management and supervision	298.857	2	.000
Duration of enterprise preparation	218.059	3	.000
Enterprise Region	135.154	4	.000
Type of enterprises activity	556.436	4	.000
Considering the needs of the region	341.802	1	.000
Legal form of the enterprise	394.758	2	.000
life of the enterprise	48.828	3	.000
Type of enterprise location (Privet/Rented)	869.154	1	.000
Number of employees	239.571	2	.000
Obstacles of starting the enterprise: Lack of funding	1.436	1	.231
Obstacles of starting the enterprise: Lack of employment	4.220	1	.040
Obstacles of starting the enterprise: The complexity of regulations	51.692	1	.000
Obstacles of starting the enterprise: un availability of a place	70.359	1	.000
Obstacles of starting the enterprise: Lack of administrative experience	45.722	1	.000
Obstacles of starting the enterprise: Difficulties marketing	11.143	1	.001
Obstacles of starting the enterprise: Absence of direction and guidance	1.875	1	.171
Obstacles of starting the enterprise: Other than the above	534.066	1	.000

Current problems of the enterprise: Difficulty in continuity of finance	15.502	1	.000
Current problems of the enterprise: Difficulty to have a place for expansion	118.161	1	.000
Current problems of the enterprise: Rising wages	12.923	1	.000
Current problems of the enterprise: Government services fees	14.183	1	.000
Current problems of the enterprise: Administrative difficulties	100.286	1	.000
Current problems of the enterprise: Competition with the local and foreign goods	1.648	1	.199
Current problems of the enterprise: Other than the above	526.183	1	.000
Sources of funding the enterprise	173.868	3	.000
Difficulties of borrowing	745.703	4	.000
Government entities that deal with it: chamber of Commerce	390.923	1	.000
Government entities that deal with it: Banks	25.502	1	.000
Government entities that deal with it: Human Resources Development Fund	16.183	1	.000
Government entities that deal with it: Ministry of Labor and Social Development	141.546	1	.000
Government entities that deal with it: Ministry of Commerce and Investment	87.040	1	.000
Government entities that deal with it: Industrial Development Fund	36.930	1	.000
Government entities that deal with it: Other than the above	2.117	1	.146
Difficulties with the official authorities	401.769	1	.000
Updating laws	361.055	1	.000
Receiving training programs and courses	194.645	1	.000
Feasibility study	164.462	3	.000
Business Incubators and Accelerators	1429.839	3	.000
Marketing mechanisms	399.421	4	.000
The role of small enterprises: creating jobs	465.231	1	.000
The role of small enterprises: limiting import	164.835	1	.000
The Role of Small Enterprises: Competition	56.733	1	.000
The role of small enterprises: varying the sources of income	267.260	1	.000
The role of small enterprises: Training local workers to do different skills	240.007	1	.000

Table (4) shows the results of this test which indicate that there are 51 variables each of them has a significant relationship with the development of the enterprise.

2.2.2 Measure the effect of all variables together:
We will use the Cox Regression Model to testing the following hypothesis:
H_0: There is no effect of independent variables on the dependent variable.
H_1: There is effect of independent variables on the dependent variable.

Table (5): Tests of Model Coefficients (Cox Regression).

Chi-Square	Df	Sig
461.527	50	.000

As it is shown in the table (5) that the statistical model that is reconciled is statistically significant. Therefore, this shows that the variables in the model have a statistically significant impact and contribution.

Table (6): Variables in the Equation (Cox regression).

	β	SE	Wald	Df	Sig	Exp(β)
Age	-.544	.192	8.068	1	.005	.580
Educational level	.540	.225	5.756	1	.016	1.716
Time available	.788	.254	9.604	1	.002	2.199
Reason for the establishing project: Academic specialization	1.593	.524	9.250	1	.002	4.921
Reason for the establishing project: Others not mentioned (love of trade or professional activity)	1.877	.461	16.543	1	.000	6.532
Number of employees	1.775	.620	8.195	1	.004	5.903
Obstacles of starting the enterprise: Difficulties marketing	-.890	.328	7.354	1	.007	2.435
Current problems of the enterprise: Difficulty to have a place for expansion	-.733	.341	4.605	1	.032	.481
Current problems of the enterprise: Rising wages	-1.049	.328	10.223	1	.001	.350

Current problems of the enterprise: Government services fees	-1.128	.375	9.025	1	.003	.324
Current problems of the enterprise: Administrative difficulties	-.691	.330	4.396	1	.036	.501
Government entities that deal with it: Banks	-.792	.257	9.484	1	.002	.453
Government entities that deal with it: Ministry of Labor and Social Development	1.081	.411	6.918	1	.009	2.948
Feasibility study	.427	.215	3.954	1	.047	1.532
Marketing mechanisms	1.148	.302	14.459	1	.000	3.150

From the table (6) can be seen the independent variables that have an impact on the development and success of the enterprise. They: age, educational level, time available, reason for the establishing project: Academic specialization, reason for the establishing project: Others not mentioned (love of trade or professional activity), number of employees, obstacles of starting the enterprise: difficulties marketing, current problems of the enterprise: difficulty to have a place for expansion, current problems of the enterprise: rising wages, current problems of the enterprise: government services fees, current problems of the enterprise: administrative difficulties, government entities that deal with it: Banks, government entities that deal with it: Ministry of Labor and Social Development, feasibility study, and marketing mechanisms.

Exp (β) values indicate that as the entrepreneurs age increases, the chance of development and success of the enterprises decreases. Also, the higher the educational level of the enterprise owner, the greater the opportunity for development and success. The opportunities of development and success of the enterprises increase due to certain factors and reasons for establishing of the enterprise, including academic specialization and other reasons such as love of trade or professional activity, as well as increasing the number of employees. The chances of development and success of the enterprise decreases, if problems of the enterprise increase. These problems include: difficulties marketing, difficulty to have a place for expansion, government services fees, rising wages or administrative difficulties. Dealing with banks reduces the opportunity for enterprise development and success due to the high rate of interest and the complexity of the procedures, unlike dealing with Ministry of Labor and Social Development. Also, doing a feasibility study for the enterprises and interest in marketing mechanisms increases the opportunity for development and success.

From the above, the Cox Regression Model can be formulated as follows:

$$\text{Log}\, h(t) = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \beta_{14} x_{14} + \beta_{15} x_{15}$$

$$\text{Log}\, h(t) = -0.544 x_1 + 0.540 x_2 + 0.788 x_3 + 1.593 x_4 + 1.877 x_5 + 1.775 x_6 - 0.890 x_7 - 0.733 x_8 - 1.049 x_9 - 1.128 x_{10} - .691 x_{11} - .792 x_{12} + 1.081 x_{13} + 0.427 x_{14} + 1.148 x_{15}$$

whereas:

x_1: Age.

x_2 : Educational level.

x_3 : Time available.

x_4 : Reason for the establishing project: Academic specialization.

x_5 : Reason for the establishing project: Others not mentioned (love of trade or professional activity, etc.).

x_6 : Number of employees.

x_7 : Obstacles of starting the enterprise: Difficulties marketing.

x_8 : Current problems of the enterprise: Difficulty to have a place for expansion.

x_9 :Current problems of the enterprise: Rising wages.

x_{10} :Current problems of the enterprise: Government services fees.

x_{11} :Current problems of the enterprise: Administrative difficulties.

x_{12} :Government entities that deal with it: Banks.

x_{13} :Government entities that deal with it: Ministry of Labor and Social Development.

x_{14} :Feasibility study.

x_{15} :Marketing mechanisms.

III. Conclusion and Recommendation

The study concludes that the most important factors affecting the development and success of Small & Medium Enterprises (SMEs) in the case of Cox Regression in the stage of development of the Enterprise from the micro to the small are: age, educational level, reason for the establishing project: Independence at work,

diversity of income sources, and others not mentioned such as love of trade or professional activity, type of enterprise location (Privet/Rented), number of employees, obstacles of starting the enterprise: difficulties marketing, current problems of the enterprise: government services fees, competition with the local and foreign goods, difficulties of borrowing, feasibility study, and marketing mechanisms. In the stage of development of the Enterprise from small to medium, there other factors include: : age, educational level, time available, reason for the establishing project: Academic specialization, and others not mentioned such as love of trade or professional activity, number of employees, obstacles of starting the enterprise: difficulties marketing, current problems of the enterprise: difficulty to have a place for expansion, rising wages, government services fees, administrative difficulties, government entities that deal with it: Bank, and Ministry of Labor and Social Development, feasibility study, and marketing mechanisms.

After getting these results, we recommend encourage a culture of entrepreneurship in the community to enable the entrepreneurs establish their enterprises, especially those with innovative and distinctive ideas that can be successful and pioneering enterprises, prepare a feasibility study that takes into account the economic, social and environmental dimensions of SMEs and reducing government fees and facilitating procedures for entrepreneurs, develop different training programs for young people to help them enter the labor market whether these programs aim at young graduates of universities and schools to provide them with the necessary skills and experience for working life, or for young people who do not have a qualification, Conduct periodic survey for SMEs to compile their own statistics to help the responsible authorities in making the appropriate decision to develop these enterprises.

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